

danger of the work in the hands of the learner who is not in a position to sift the wheat from the chaff and the weeds?

We do not think that this book will serve to advance the reputation of its author, nor to advance agriculture. We submit that "advanced agriculture" is not agriculture *plus* a smattering of chemistry, a dip into geology, a pinch of botany, a skim of entomology, a sniff at meteorology, and so on; even if the sciences be correctly expounded. The text-book of agriculture, like that of other subjects, has no doubt to pass through stages of evolution, and we trust it will not long remain at the stage indicated by this book.

EWING ON THE STEAM ENGINE.

The Steam Engine and other Heat Engines. By Prof. J. A. Ewing, M.A., B.Sc., F.R.S., M.Inst.C.E. (Cambridge: The University Press, 1894.)

ENGINEERING students and others will welcome the present volume as one likely to increase their knowledge of an important branch of engineering, from the pen of an acknowledged master of the science; any work by Prof. Ewing is sure to be read by engineers generally, and treated as a book for constant reference.

As is well known, Prof. Ewing wrote some valuable articles for the "Encyclopædia Britannica" on this subject, and it is an expansion of these articles which constitutes the basis of this work. As a University text-book this volume will fill a great want, treating as it does, from the theoretical side, a subject only descriptively dealt with in the majority of such text-books. As the author remarks: "The endeavour throughout has been to make evident the bearing of theory on practical issues."

The first six chapters may be said to contain the early history of the steam engine, and a scientific treatment of the general behaviour of steam in the cylinder, as well as the general theory of heat engines. The information thus brought together is of a valuable nature, and the references which are made, add considerably to the usefulness of the work. To the thoughtful practical engineer, this portion of the book will form a perfect mine of matter for careful consideration.

The testing of steam engines has of late years become a common occurrence, thanks to Profs. Kennedy, Osborne Reynolds, and many others. Designers and manufacturers of such engines have everything to gain by such experiments; few being, like the late Mr. Willans, capable of carrying out scientifically accurate trials of their own engines. Chapter vi. deals with this important question. Many useful hints are given, and sources of error carefully pointed out. As indicator diagrams play such an important part in the trials of steam engines, it is interesting to note that the Crosby Company's modified form of Richards' Indicator is considered by Prof. Ewing to be one of the best.

Compound expansion comes in for very full and accurate treatment; many sets of indicator diagrams are explained and illustrated, and the difficult matter involved in the combination of such diagrams is lucidly dealt with. Of the advantages of compound expansion in the

use of high-pressure steam, we are told much, and also of the mechanical advantages of such an arrangement. We cannot help pointing out that, in this matter, the practical men on the Clyde were singing the praises of compound engines before the theoretical men would admit of their utility or economy. On valves and valve gears our author has much to say, although we notice nothing remarkable in the chapter. Locomotive engineers do not trust entirely to the drawing-board or calculation in the design of valve gears. It is now the practice to try the proposed gear as a full-size model on the valve gear testing machine, and so to obtain the best results. The latest machine of this kind has been erected in the drawing-office of Messrs. Sharp, Stewart, and Co., the eminent locomotive engineers, of Glasgow. The saving of time is great, and very accurate results are obtained. In fact, in such drawing-offices, the old valve diagrams, with their many curves, are things of the past, and a simple table of leads, cut-offs, suppressions, &c., for the different degrees of expansions, has taken their places.

Chapter ix. treats of the many forms of governors used for regulating the work done in the steam engine, commencing with Watt's simple arrangement, and finishing with the differential or dynamometric governors invented by the late Sir W. Siemens; and further on in the book we find much useful information concerning the work on the crank shaft. Diagrams of crank efforts are given, and the effect of friction and of the inertia of the reciprocating pieces are duly discussed. The balancing of machinery is an all-important subject, in fact the life of any machine depends upon the balancing of its moving parts; for this reason, we are sorry to see that Prof. Ewing has so little to say on this subject generally, and particularly on the balancing of locomotives. If theory is of any help to the locomotive engineer at all, surely it could be best applied in balancing; some engineers balance the whole reciprocating weight, others none; the majority about 30 per cent.: which is right. Prof. Ewing does not help us, but observes that "the final adjustment of the balancing masses is usually a matter of experiment, the locomotive being hung in chains to allow its oscillation to be observed"; this, to say the least of it, is never done in this or any other country.

The production of steam is the subject treated in the following chapter; the illustrations of the different boilers, with the descriptions, are excellent. The only specimens of water-tube boilers illustrated are the Thornycroft and the Babcock and Wilcox, the latter used principally for stationary engines. The Thornycroft boiler is the forerunner of similar types; for instance, the Yarrow and the Clyde among others, all of which are considerably lighter than the ordinary marine boiler. As an example of the locomotive boiler, one of the London and North-Western Railway Company is taken as typical of British practice. As an example of an injector for feeding boilers, an old-fashioned type of Giffard injector is illustrated, but more recent types are described. Mechanical stoking and the use of liquid fuel are also mentioned.

The following chapters conclude the work, occupying some sixty pages with descriptions of forms of steam engines, air, gas, and oil engines. The Willan's central

valve engine is well illustrated, and the description does credit to what is probably the most economical steam engine ever designed. A description is given of rotary engines, but none are illustrated. The "Rota" engine, designed and made by MacEwan Ross, of Glasgow, might have been included with advantage. The locomotive is outlined, and the compound type described; but no information as to tests is given, probably because no trustworthy data can be obtained; and as no British Railway Company, with one possible exception, is likely to build any more compound engines, it seems probable they are not the unqualified success they were originally claimed to be, although the Vaucrain system, with four outside cylinders, appears to be a success in the States. But it must not be forgotten that the American rival is a very uneconomical engine when compared with our own.

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OUR BOOK SHELF.

Das Verhältniss der Philosophie zu der empirischen Wissenschaft von der Natur. By David Wetterhan. (Leipzig: W. Engelmann, 1894.)

THIS is the essay which gained the prize of 1000 marks offered, in 1891, by the Philosophical Society of Berlin. It consists of 110 pp., of which about twenty are occupied by notes and abstracts from various writers, in small print.

Naturally, in giving forth his own views, some of which possess considerable originality, the author makes continual and extensive use of the theories of Kant, Schopenhauer, Wundt, Bunge, and others; and one noticeable feature about the work is the full share of recognition accorded to English philosophers and scientists, such as Faraday, Herbert Spencer, Darwin, Romanes, and Huxley. The writer well remarks that the limits of scientific knowledge are everywhere and nowhere.

In the earlier pages the author discusses the relation between the physical and the psychical sides of nature. The theory of the conservation of energy has nothing to do with mental processes: it governs the quantitative relations of all processes of nature, but does not explain their qualitative differences. Sensation, consciousness, motor impulse, are not forms of energy, and do not correspond to them, but to the causes of qualitative changes in forms of energy.

The world of psychics cannot be separated from that of physics, and we must look forward to the future progress in the latter science to bring the qualitative changes into connection with the theory of the conservation of energy. The author shows by a very simple example—"Shall I kill that spider, or leave it alone?"—the effect of his will on surrounding nature; and the divergent effects thereon which would result from each of the two alternative modes of procedure.

Memory he believes to be caused by an impulse of a certain kind, producing in the particular arrangement of the smallest particles in the ganglion cells and nerve fibres a modification in the same direction as was produced by the original impulse, and resulting in corresponding physical phenomena. But he acknowledges that, at present, we cannot explain "brain oscillations."

The principle of evolution sheds a light upon the psycho-physical problem: physical development is not the cause but the effect of psychical development, and the modifications in the brain and nervous system throughout the animal kingdom are intelligible as resulting from psychical causes, whereas the physical causes, if

they exist, remain hidden. He considers that even in palæontology we can detect traces of this psycho-physical process by the examination and comparison of the cranial capacity of the skulls of extinct reptiles and mammals. As man is the culminating point in mental development amongst mammals, so is the ant amongst insects; but clearly this position has in each case been attained independently, and is independent of the structure of the nervous system. The inheritance of acquired characters is discussed, and the old difficulties presented by a disbelief in it are once more brought forward; and especially the difficulty in the adaptation of terrestrial mammals to a life in water, such as must have occurred in the ancestors of the Cetacea. The author endeavours to show that the principle of progressive psycho-physical development may admit of a vital-mechanical explanation, if the transference of acquired characters, as a consequence of changed functions, is possible for "keimplasma."

The author is apparently a practical man of science, and not a mere arm-chair philosopher; he fully recognises that philosophy must be based upon scientific experiments, and quotes Huxley's words, "The Laboratory is the forecourt of the temple of Philosophy."

Meteorology, Practical and Applied. By John William Moore, B.A., M.D., M.Ch., F.R.C.P.I. (London: F. I. Rebman, 1894.)

IT is to be hoped that this little book may meet with the popularity it deserves. Well written and well illustrated, it ought to recommend itself to that numerous class of whom some knowledge of meteorology is now required. The author, a medical practitioner, has evidently, first of all, but by no means exclusively, sought to interest medical officers of health and those who seek a qualification in preventive medicine and its allied branches. Writing for such students, the author has prudently not burdened his work with technical terms, or attempted to discuss with any completeness the general motions of the atmosphere depending upon the application of thermodynamics. Neither does he fall entirely into the popular and pleasing style of writing; though he does seek legitimate interest by exhibiting the many points in which meteorological inquiry bears on social and sanitary science, how it may benefit the agriculturist, protect the traveller, or instruct the physician.

The book is divided into four sections. In the first we find a very full and, considering the source from which it is drawn, probably accurate account of the history and development of the United States Weather Bureau. It seems to have occurred to the author, that if he shows to the reader at an early stage the interest and devotion which the shrewd American gives to this subject, he will convince him that there is something in meteorology after all, beyond the dreary and wearisome accumulation of barometer and thermometer readings. Then we have, of course, the description of the necessary instruments in use, with their corrections. We are glad to see in this section due prominence given to Mr. Aitken's interesting work on atmospheric dust; and in the chapter on evaporation we notice that Mr. Apjohn's formulæ are given correctly, which is not the case in some other well-known elementary works. The third section of the book treats of climate and weather, a section that might with advantage have been made fuller; but in reviewing the whole subject of meteorology within moderate compass, it is necessary to curtail somewhere. The last section considers the influence of season and weather on disease. Here the author is apparently on very familiar ground, and the small space devoted to this topic is full of interest and suggestion. There are one or two slips in the text, as, for instance, on page 10, where the oft-repeated